



CAMBRIDGE

***Climate Protection
Action Committee***

2004

ANNUAL REPORT



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CLIMATE PROTECTION ACTION COMMITTEE

2004 ANNUAL REPORT

Executive Summary

The Climate Protection Action Committee is an advisory body appointed by the City Manager to assist the City in implementing the Climate Protection Plan. The 2004 Annual Report, which is the first to be issued, describes and evaluates the current status of Cambridge's efforts to achieve the goals of the plan.

Participation in the ICLEI Cities for Climate Protection program is expanding. There are currently over 600 participating local governments around the world, including 148 in the U.S. and 21 in Massachusetts. Actions to reduce the greenhouse gas (GHG) emissions that are the primary cause of climate change, or global warming, are also expanding. The scientific consensus has grown stronger that climate change is already happening and that GHG emissions from human activities are the primary cause, as reflected in new scientific reports such as the *Arctic Climate Impact Assessment* issued in 2004. Action at the regional, state, and local levels continues to build, as exemplified by the Massachusetts Climate Protection Plan and the Regional Greenhouse Gas Initiative (RGGI), which is a regional effort to create a cap and trade system for GHG emissions from power plants in the New England states plus New York.

Based on an update of the Cambridge GHG emissions inventory for 2003, our greenhouse gas emissions have continued to increase. Since 1990, total GHG emissions have increased to from 1.16 million tons of carbon dioxide (CO₂) to 1.48 million tons of CO₂ in 2003, a 27.2% rise. The largest cause of the increase is related to increased emissions from commercial, industrial, and institutional sources. This sector has expanded significantly in floor area since 1990 and energy intensive activities appear to have expanded. On a positive note, GHG emissions on a per square foot basis have decreased about 5%, reflecting an improvement in energy efficiency. GHG emissions from transportation have also increased to a lesser degree, reflecting the increase in vehicle miles traveled and the decrease in average fuel economy of vehicles. Residential GHG emissions have declined by about 25% since 1990, probably as a result of the extensive home renovations that have taken place in Cambridge and the effect of utility energy efficiency programs. Emissions from waste generation have also declined as a result of recycling and waste prevention efforts.

The City has taken responsibility for GHG emissions from municipal operations as demonstrated by development of a systematic approach to building energy management; purchasing of green power; conversion of diesel vehicles to 20% biodiesel; installation of LED fixtures in traffic signals; expanded transit incentives for employees; implementation of green building design for major projects; and environmentally preferable purchasing practices.

In the community, institutions, businesses, other organizations, and citizens are actively engaged in reducing GHG emissions. The connection between climate change and energy use, transportation, and waste generation is becoming clearer to those responsible for facility and household management. The terminology of climate change has become increasingly common; environmental impacts are expressed in terms of GHG emissions and the goal of mitigating climate change is often explicitly stated. Harvard and MIT have comprehensive programs aimed at improving the sustainability of their campus operations. Both universities have conducted GHG emissions inventories, have goals to reduce emissions, and have taken significant steps in energy, transportation, and waste management. NSTAR continues to provide energy services, including a wide range of audit and rebate programs to residential and commercial customers. NSTAR also collaborated with the City to present the first Energy Fair as part of Danehy Park Family Day. Businesses such as Cambridge Savings Bank and Hines, which manages Riverfront Office Park in Kendall Square, are saving energy and benefiting financially while setting great examples for the business community. Six places of worship are participating in Massachusetts Interfaith Power and Light, which helps the faith community implement energy conservation and renewable energy actions. Renewable energy is taking hold through installation of solar photovoltaic systems and the purchase of renewable energy certificates to offset GHG emissions. Cambridge is becoming a hotbed for green buildings, with 12 projects registered with the U.S. Green Building Council. Several institutions and businesses have joined with the City to increase their recycling rates to 40% by the end of 2005.

Cambridge, across all of its sectors, is gaining experience in understanding its contribution to climate change and developing actions to mitigate it. The Committee sees the need to develop a community-wide campaign to engage significant numbers of businesses, institutions, organizations, and citizens, increase energy efficiency in the existing building stock, ensure that new buildings exceed the minimum state energy code, greatly expand the purchase of green power and installation of renewable energy generating capacity, encourage the purchase of fuel efficient and alternative fuel vehicles, continue to press for increased use of alternatives to single-occupancy vehicle trips, and continue to prevent waste and increase recycling.

A number of opportunities present themselves for action in 2005, which the City and the Committee will pursue. The Committee will continue to monitor indicators of GHG emissions and report again on progress in a year.

PURPOSE OF THE ANNUAL REPORT

The Climate Protection Action Committee is an advisory body appointed by the City Manager to assist the City in implementing the Climate Protection Plan. Part of the committee's charge is to monitor activities and report annually on the status of efforts to achieve Cambridge's goal of reducing greenhouse gas emissions by 20 percent below 1990 levels by 2010. Since this is the first annual report issued by the committee, it includes activities in 2003 in order to cover the period since the approval of the Climate Protection Plan in December 2002.

CITIES FOR CLIMATE PROTECTION

The City of Cambridge joined Cities for Climate Protection (CCP) in 1999 through the passage of a City Council resolution. CCP, a campaign sponsored by the International Council for Local Environmental Initiatives (ICLEI), is a network of local governments working to reduce the greenhouse gas emissions that are causing global climate change. Since 1999, the CCP campaign has grown from 55 to 148 participating local governments in the U.S. and from 4 to 21 in Massachusetts alone.

Cities for Climate Protection Participants (as of December 2004)

International	624
United States	148
Massachusetts	21

Since 1999, the scientific consensus has grown stronger that climate change is already happening and that greenhouse gas emissions from human activities are the primary cause. In addition to the reports of the Intergovernmental Panel on Climate Change (IPCC) and the National Academy of Sciences, the American Meteorological Society, the American Geophysical Union, and the American Association for the Advancement of Science have issued statements concluding that the evidence for the human role in climate change is compelling. Internationally, the will to act has also grown stronger. With Russia's ratification of the Kyoto Protocol, the pact took effect on February 16, 2005.

Massachusetts CCP Participants

Amherst	Medford
Arlington	Natick
Barnstable	Newton
Boston	Northampton
Brookline	Salem
Cambridge	Shutesbury
Falmouth	Springfield
Gloucester	Somerville
Lenox	Watertown
Lynn	Williamstown
	Worcester

While the U.S. has withdrawn from the treaty, actions at the regional and state levels have accelerated. All six of the New England governors have entered into a regional climate change action agreement with the five eastern Canadian premiers.

State legislation in Maine and Connecticut has formalized the commitments of those states. Governor Mitt Romney issued the Massachusetts Climate Protection Plan in April 2004. California, Oregon, and Washington have jointly agreed to a set of climate

protection actions under the West Coast Governors' Global Warming Initiative. The New England states and New York are presently developing a regional greenhouse gas cap and trade system for power plants. The plan for the system is expected to be released in April 2005. California issued regulations in 2004 requiring automobile manufacturers to reduce greenhouse gas emissions from vehicles sold in that state by 30 percent, although the regulation is being challenged in court.

Major Scientific Reports Since 1999

- International Panel on Climate Change, *Third Assessment Report*, 2001
- National Academy of Sciences, *Climate Change Science: An Analysis of Some Key Questions*, 2001
- Arctic Council, *Impacts of a Warming Arctic: Arctic Climate Impact Assessment*, 2004
- Pew Center on Global Climate Change, *Observed Impacts of Climate Change in the U.S.*, 2004

The CCP campaign sets five milestones for participants to accomplish:

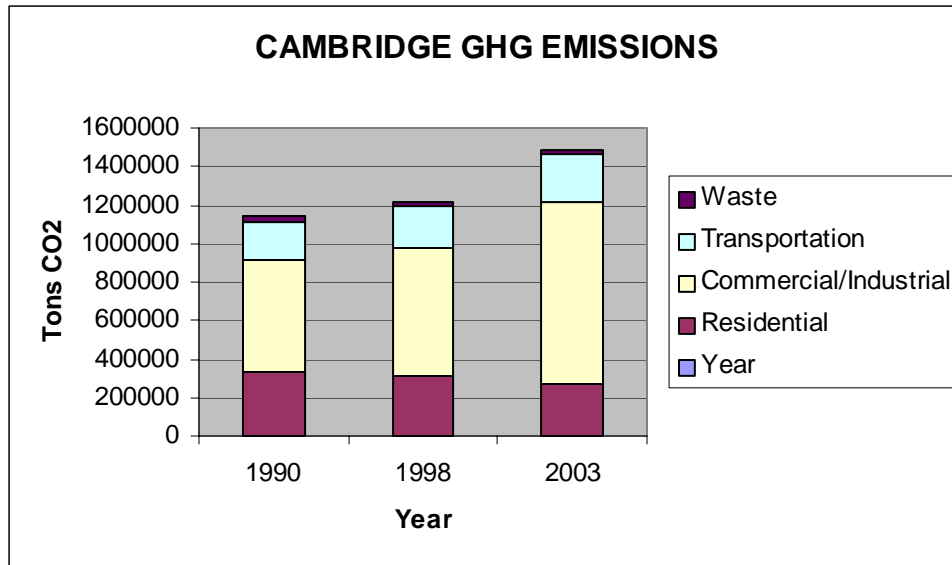
- Prepare a greenhouse gas emissions inventory
- Set an emissions reduction target
- Develop a local action plan
- Implement the local action plan
- Monitor results

Cambridge completed the emissions inventory in 1999. A Climate Protection Plan, with a target of reducing greenhouse gas emissions by 20 percent below 1990 levels by 2010, was approved by the City Council in December 2002. Various actions are in progress to implement the plan and with the 2003 update of the emissions inventory, results are being monitored. Therefore Cambridge has reached all five CCP milestones, although implementation and monitoring are ongoing.

GREENHOUSE GAS EMISSIONS INVENTORY

Community-wide greenhouse gas emissions were previously inventoried for the years 1990 and 1998. The inventory has been updated for 2003. The same categories of emissions have been assessed in all three years using consistent sets of emission factors (e.g., pounds of CO₂ per kilowatt-hour).

The 2003 inventory indicates that total emissions for the community have continued to increase, rising by 27.2 percent between 1990 and 2003. In comparison, U.S. GHG emissions have increased 13.4 percent between 1990 and 2002 according to the U.S. Department of Energy.



Year	1990	1998	2003
Residential	325,431.50	309,865.60	263,266.70
Commercial/Industrial	582,862.80	667,355.10	951,944.90
Transportation	205,855.40	218,960.40	251,929.10
Waste	23,484.80	14,886.60	15,117.80
Total GHG Emissions	1,164,634.60	1,211,067.70	1,482,218.40

Total residential emissions in Cambridge have declined since 1990 by 25.3 percent. While electricity use increased by 32.7 percent, this was more than offset by declines in natural gas (36.1%) and fuel oil (38.0%) use. This may be in part due to particular weather conditions in 2003, but the trend is consistent with the decline seen in 1998. Similarly, emissions per household declined from 8.9 tons in 1990 to 6.9 tons, or 29 percent, in 2003 indicating increased energy efficiency in residential households.

Increased emissions from the commercial/industrial sector contribute most of the increase in total emissions. Since 1990, commercial/industrial emissions in Cambridge have risen 63.3 percent. Emissions from electricity, natural gas, and fuel oil consumption all increased. During the same period, commercial and industrial floor space rose 73.2 percent. Electricity use increased 39.3 percent, which was significantly slower than the increase in floor area.

In terms of emissions per commercial/industrial area, emissions for the sector declined from 56 pounds per square foot to 52.8 pounds per square foot (-5.7%), indicating increased energy efficiency in commercial and industrial buildings.

Transportation emissions also increased 22.1 percent from 1990 to 2003. Vehicle miles traveled rose 25.4 percent in that period in Cambridge. National average fuel economy declined between 1990 and 2000 according to the Congressional Research Service,

dropping from 25.4 miles per gallon (mpg) to 24.7 mpg. This was in part due to the growing popularity of sport utility vehicles (SUVs). In Cambridge, this is reflected in the vehicle registration statistics. From 1990 to 2003, total vehicle registrations increased from 44,856 to 56,282, a 25.5 percent increase. Registrations of light trucks, which include SUVs, increased from 2,972 to 9,672, a 225.4 percent increase.

Emissions from waste declined between 1990 and 2003, dropping by 35.6 percent. This is largely due to the success of the City's recycling program, which commenced in 1990. Since 1998, emissions have been relatively stable. It should be noted that in this inventory, solid waste not collected by the City is not included due to the lack of data. Most commercial waste and some large residential buildings use private haulers to collect their waste. Based on state statistics, it is likely that Cambridge's overall emissions in this sector would double if waste from the commercial sector is taken into account.

CITY INITIATIVES

Energy Sector

Energy Management Work Group – The City Manager created the inter-departmental Energy Management Work Group to evaluate the energy performance of City-owned facilities, identify and implement energy efficiency measures, and make recommendations on administrative steps. The work group is chaired by the public works department and includes staff from the community development, school, electrical, library, and purchasing departments.

- Tracking Energy Use - The work group has been collecting data and reorganizing administrative procedures to track City energy use. Due to the large number of bills tied to dozens of individual meters and the focus on monetary cost, the pattern of energy use was not previously well understood. DPW has completed the conversion of bills under its control to statement billing, which consolidates the billing and allows staff to access energy use and cost information in electronic format. This makes tracking energy use much more efficient. The School Department is also in the process of converting to statement billing.
- Benchmarking - Through an NSTAR program, City Hall has been evaluated with the Energy Star benchmarking tool, which compares the energy performance of buildings to national averages for certain building types and provides a basis for improving performance.

2003 Energy Consumption Per Square Foot			
City Buildings	Electricity (KWH)	Gas (cubic feet)	Total (Thousand BTUs)
<i>National Average – All Commercial Buildings</i>	13.8	43.2	85.1
344 Broadway	8.5	0.0	29.1
Frisoli Youth Center	10.2	34.7	69.5
Lombardi Building	13.4	2.0	87.9
Coffon Building	12.0	59.6	100.4
City Hall	13.5	70.6	116.7
Area 4 Youth Center	11.2	87.6	125.5
DPW Complex	5.5	123.1	141.9
Moore Youth Center	5.3	146.3	164.5
Senior Center	25.1	89.0	174.6
Cemetery (3 bldgs)	13.7	170.0	216.6

- Audits & Engineering Studies - DPW is overseeing engineering studies on the heating, ventilation, and air conditioning systems for City Hall, 51 Inman Street, and the Senior Center. NSTAR Gas funds 50 percent of the studies.
- Building Upgrades - The Electrical Department is working with the Traffic, Parking, & Transportation Department to install high efficiency lighting in the new office space at the First Street Garage. With rebates from NSTAR's small commercial and industrial program, NSTAR will be paying the City beyond the actual cost for purchasing and installing the lighting.
- Vending Miser - Vending Miser devices are being tested on cold beverage vending machines. The devices use motion detectors to power down vending machines during low use periods, while ensuring that the cooling equipment runs enough to keep beverages cold. A trial conducted on a machine at City Hall reduced electricity use by 22 percent. The School Department is currently testing the device.
- Energy Efficiency Purchasing - The work group has drafted an energy efficiency purchasing policy to ensure that the equipment purchased for use in City facilities is efficient. The Purchasing, Public Works, and Community Development Departments have been working jointly on this policy.
- LED Traffic Signals - The Traffic, Parking, and Transportation Department is routinely replacing incandescent fixtures in traffic signals with light emitting diode (LED) fixtures. While LEDs initially cost more to purchase, they use 80 to 90 percent less electricity than incandescent bulbs and last 6 or more years. The City saves financially as a result through lower utility bills and reduced maintenance costs. To date, the Traffic, Parking & Transportation Department has converted signals in about 22 percent of intersections, reducing annual electricity usage by about 92,000 kilowatt-hours and annual CO₂ emissions by

about 32 tons. Systematic replacement of incandescent fixtures continues and will be completed within the three years.

Green Power - Green power is electricity produced from renewable sources such as solar, wind, landfill gas, small-scale hydropower, and biomass, all of which produce zero or lower greenhouse gas emissions. Electricity delivered by NSTAR includes a small percentage generated by renewable sources located elsewhere in the region. In Cambridge some properties have solar photovoltaic systems that generate electricity to generally provide a portion of a property's power needs and reduce the amount of electricity purchased from NSTAR.

A new method of purchasing green power has become available to consumers. Renewable energy certificates (RECs) represent the "green" attributes of a given quantity of electricity (e.g., the pounds of GHGs per kilowatt-hour). When consumers buy RECs they create economic demand for renewable energy, which spurs investment in new facilities to generate green power. The City is generating green power through installation of solar PV systems and through the purchase of RECs. A 26-kilowatt PV system, funded with a grant from the Massachusetts Technology Collaborative, was installed on the roof of City Hall Annex as part of the green building renovations. The system provides about 10 percent of the Annex's power needs.

Renewable Energy Certificates

RECs, also called "green tags", represent the environmental and social attributes of electricity generated by renewable energy sources such as solar, wind, biomass, and others. For example, a REC may represent the amount of greenhouse gas emissions avoided compared to the average emissions for the regional electricity grid, which uses coal, oil, and natural gas. These attributes are certified by independent sources and can be sold. Companies, institutions, government agencies, and individuals buy RECs to offset the negative environmental and social impacts of their energy use.

For the first time, the City has contracted to buy RECs. Through an electricity aggregation agreement negotiated by the City Manager and the Electrical Department with Bay State Consultants that will take effect in March 2005, the City will acquire RECs representing 760,000 kilowatt-hours of renewable energy over two years, which represents two percent of the City's electricity load. This reduces GHG emissions by 140 tons of CO₂ in each year of the contract. Conventional air pollutants are reduced by 1,506 pounds per year.

Transportation

Alternative fuels – The Public Works Department switched its main diesel fuel tank to B20 biodiesel in August 2004. Biodiesel is a refined form of vegetable oil. The B20 product contains 20 percent biodiesel and 80 percent conventional diesel. Biodiesel is beneficial to public health and the environment because it reduces the emissions of most conventional air pollutants including particulates. And because it is the product of an agricultural crop, usually soy beans, the fuel is renewable and offsets the emission of

carbon dioxide, since the plants absorb CO₂. About 80 municipal diesel vehicles refuel at the public works yard, including the Water and School departments. About half of Cambridge's school buses are owned by the City and refuel there. All of the trash packer trucks are running on biodiesel. DPW estimates that about 60,000 gallons of B20 will be used in FY05, which would result in a greenhouse gas reduction of 132 tons. The decision to switch to biodiesel followed a pilot project conducted jointly by the Public Works and Water Departments in 2003-2004.

The City also operates about 20 GEM neighborhood electric vehicles. These vehicles were given to the City by Daimler Chrysler in 2003 through arrangements with Mayor Michael Sullivan. The vehicles are used by the Public Works, Fire, Water, and Recreation Departments. There are no tailpipe emissions associated with GEM cars.

The Water Department owns a compressed natural gas (CNG) pickup truck that is used in the Cambridge reservoirs watershed. The vehicle, which is refueled at the AVSG CNG station on Route 128, reduces annual GHG emissions by an estimated 8 tons.

Transit incentives – To encourage City employees to commute to work by means other than single-occupancy car trips, the City offers a set of incentives. In 2004, the City Manager expanded the incentives by raising the MBTA transit pass subsidy and starting a guaranteed ride home program and Internet-based carpool matching program. At present 345 (not including School Department employees) of the City's 3,196 employees purchase MBTA passes through the City program. The City is a member of the Charles River Transportation Management Association, which helps employers provide transportation services such as the EZ Ride shuttle bus. Several departments provide City bicycles to staff to use for work purposes. The Community Development Department is piloting the use of car-sharing services through a contract with Zipcar that allows department employees who do not drive alone to work to have use of a Zipcar for work purposes.

Land Use and Buildings

Green Buildings – It is City policy that all new construction and major renovations be done in accordance with green building principles. The City follows the Leadership in Energy and Environmental Design (LEED) guidelines of the U.S. Green Building Council (USGBC). By following green design principles in its own projects, the City hopes to encourage the private sector and other public entities to do the same.

The renovation of City Hall Annex represents the City's first municipal green building project. The Annex, which was rededicated in February 2004, features a ground-source heat pump system for heating and cooling, extensive daylighting, double-paned windows with low emissivity coating, a solar photovoltaic system, certified wood, low-emitting paints, finishes, and adhesives, and building materials with recycled content. The City is awaiting a LEED certification from the USGBC.

The Russell Field field house is currently under construction and is expected to achieve LEED Certified status. The main library expansion has been designed with LEED and bids will be solicited for construction shortly. Plans are being prepared for the renovation of the War Memorial gymnasium at the high school using the LEED guidelines.

The School Department, with a grant from the state Renewable Energy Trust, prepared a feasibility study for energy efficiency and renewable energy options at Cambridge Rindge and Latin High School in 2003. The study's findings will be considered when renovation of the high school is scheduled.

Tree planting – The Public Works Department Urban Forestry Program is responsible for maintaining all trees in the public way and in City parks. There are an estimated 15,000 trees for which DPW is responsible. Maintenance of the urban forest supports the tree canopy, thereby reducing the urban heat island effect. Cooler summer temperatures reduce energy demand for cooling in buildings. Street trees also make streetscapes more attractive, thereby encouraging walking.

Waste Management

Food composting project – In spring 2004, DPW hosted an intern to explore opportunities to begin food waste collection at the public schools including the possibility to purchase biodegradable products instead of plastic and Styrofoam products for lunchroom food service (bowls, trays, spork kits, etc.). Based upon two cafeteria waste sorts, an estimated 205 tons of food waste is thrown out annually in addition to about 7 tons of Styrofoam and plastic food service items currently being recycled. The Styrofoam program costs the City about \$13,000 annually and disposing food waste costs about \$18,000 annually in tip fees. Ultimately, the DPW would like to collect food waste and biodegradables in the same truck for composting and eliminate the costly Styrofoam program.

Currently, the cost of biodegradables is three times the cost of currently purchased items and is entirely prohibitive. However, the intern identified several universities and Massachusetts communities interested in purchasing biodegradable products if the costs were lower. In spring 2005, DPW will receive in-kind Massachusetts Department of Environmental Protection staff time through a grant to establish a strategy and coordinate the implementation of a purchasing collaborative or state contract in order to lower the cost of biodegradables and make the purchase of these products a real alternative for communities and institutions in the Commonwealth.

Environmentally Preferable Purchasing (EPP) - An environmentally preferable purchasing practices policy is in place, which encourages City departments to buy environmentally preferable products when cost, performance, and availability are not compromised. The state currently has over three dozen contracts for environmentally preferable products. Municipalities are able to purchase through the state contracts.

Purchasing Department staff work with City departments to identify EPP alternatives and ensure that the policy is followed.

To make it easier for City employees to view and select products made from recycled materials, the City's vendor of office supplies, *Corporate Express*, created a shortcut global shopping list of EPP products most commonly purchased by city employees on its website at www.eway.com. Employees just have to click on "shopping lists" and then "recycled products" to access this new tool.

COMMUNITY INITIATIVES

Energy

NSTAR Programs – NSTAR, which provides electricity and natural gas to most properties in Cambridge, offers a wide range of energy services and energy efficiency rebates. NSTAR reports that 17,350,463 kilowatt-hours of electricity was saved in 2003 and \$2,084,958 in incentives was provided to Cambridge residential, commercial, industrial, and institutional customers. The current list of services and rebates for residents and businesses is available on NSTAR's website.

Energy Fair- The Community Development Department and NSTAR joined forces to organize the first annual energy fair as part of Danehy Park Family Day held on October 3, 2004. Thousands of Cambridge residents were given information about NSTAR's energy efficiency services and rebates and participated in raffles for Energy Star-rated lighting products and a front-loading washing machine. There were also displays about energy efficient lighting, renewable energy, and the climate protection plan. The Department arranged for the Chewonki Foundation to bring its energy education display. A NESEA volunteer displayed solar energy toys and models to appeal to children. And Green Decade/Cambridge offered literature and discussion about climate change.

Community Solar Power Initiative - MIT created a program to showcase solar energy in Cambridge and nearby communities. The Massachusetts Technology Collaborative provided \$505,701 in grants which MIT used to subsidize the purchase of systems and to install some on campus. MIT has helped install 5 residential systems in Cambridge and put 3 others on campus. Altogether, the program has installed about 36 kilowatts that will produce an estimated 39,000 kilowatt-hours of electricity annually. The program is now fully subscribed and MIT does not expect to obtain additional funding to extend it. Production data from two Cambridge residential systems can be viewed at www.soltrex.com.

MIP&L – Massachusetts Interfaith Power and Light is a non-profit organization founded to help places of worship to be better environmental stewards through their energy use. It is open to all faiths. There are currently 68 places of worship that have joined MIP&L, including six in Cambridge. By joining, places of worship gain access to energy services including in-depth audits, financial planning, technical advice, and purchasing of

renewable energy certificates. MIP&L has contracted with Conservation Services Group, an energy services company, to provide the services.

MIP&L in Cambridge

Christ Church
Episcopal Divinity School
First Parish UU
Friends Meeting
St. James Episcopal Church
St. Paul's Parish

Energy Star Partners – The federal Energy Star program encourages businesses, government agencies, and other organizations to participate as partners. Partners make a written pledge, signed by the chief executive officer or chief financial officer committing to measure and benchmark energy performance of their facilities, plan and implement improvements, and educate employees and customers about energy efficiency. Several Cambridge organizations and businesses are Energy Star partners. In 2003 and 2004, Cambridge Savings Bank and Hines, the international real estate management firm, received recognition from the Environmental Protection Agency for improving their energy performance.

Cambridge Savings Bank reduced its energy use by 22 percent between 2001 and 2002, saving 460,000 kilowatt-hours of electricity and \$60,000 in utility costs annually. The energy reductions were achieved while adding two new bank branches. The bank's Cambridge headquarters in Harvard Square was awarded an Energy Star label in 2003 for its high energy performance.

Energy Star Partners in Cambridge

Bed & Breakfast Inn
Cambridge Family and Children's Service
Cambridge Savings Bank
Camp Dresser McKee
City of Cambridge
Gravestar
Harvard Crimson
Holmes Unlimited Realty Corporation
Just a Start Corporation
Lesley University
MRPA
The Resource Technologies Group
ROG, Inc.
Smarter Living, Inc.

The Riverfront Office Park building at One Main Street, managed by Hines, was awarded an Energy Star label in 2003. Hines also received the Energy Star Sustained Excellence Award in 2004. The 471,600 s.f. office building was retrofitted with compact fluorescent lighting, occupancy sensors, increased roof insulation, and variable frequency drive fans to improve energy performance. Hines has an extensive tenant energy efficiency education program. Electricity use was reduced by 2.5 million kilowatt-hours saving \$241,300 in annual costs. Hines was also recognized with a Go Green Award by the City.

GreenFuel – An example of the innovation that can happen in Cambridge is embodied by a local startup company, GreenFuel, that has invented a bioreactor to remove carbon dioxide from a power plant's emissions and turn it into a useful product. A prototype of the bioreactor has been installed on MIT's power plant on Vassar Street. Essentially, it consists of a network of tubes that support algae growth. The algae absorb carbon dioxide and other pollutants from the power plant's emissions. The algae can be harvested and processed into biodiesel. The company is currently seeking partners to participate in scaling the system up to a commercial level.

Transportation

TDM measures – The Vehicle Trip Reduction Ordinance, passed in 1992, and the Parking and Transportation Demand Management (PTDM) Ordinance, passed in 1998, establish policies and programs to encourage alternatives to single occupancy vehicle trips.

By requiring transportation demand management plans, the PTDM Ordinance has prevented or reduced 22.1 million vehicles miles traveled annually for the first 14 projects for which monitoring data is available. Assuming the vehicles are primarily sedans, greenhouse gas emissions of 11,300 tons per year are avoided.

Bicycle, pedestrian, & traffic calming measures – The Community Development Department manages bicycle and pedestrian planning and coordinates with the Public Works and Traffic, Parking, and Transportation Departments on construction of improvements. Installation of bicycle parking, bicycle lanes, pavement markings, traffic calming measures, sidewalk improvements, and intersection improvements are used to improve the biking and walking environments. Cambridge currently has 13.5 miles of bicycle paths and multi-use paths and 9.5 miles of bicycle lanes. Given the city's density and mix of uses, walking and biking are often practical alternatives to driving.

Alternate Fuels – Harvard has converted its fleet of 42 diesel vehicles to B20 biodiesel. New refueling equipment was installed at Harvard's Allston vehicle yard at a cost of \$50,000.

Under a partnership, MIT and the Department of Public Works successfully applied for a grant from the EPA's voluntary retrofit grant program. The grant will enable the City and MIT to install pollution control equipment on diesel vehicles to reduce particulate and other air pollution emissions. While the project does not directly reduce greenhouse gas emissions, it will enhance the positive greenhouse gas reduction benefits of the City's recent conversion to biodiesel.

Land Use and Buildings

Green Buildings – Cambridge has become a hotbed for green buildings. The use of the U.S. Green Building Council's LEED green building guidelines has become common, although it does not yet characterize the majority of new construction in Cambridge.

LEED REGISTERED PROJECTS IN CAMBRIDGE

<u>Projects</u>	<u>Owner/Developer</u>
90 Mt. Auburn Street	Harvard University
Brain & Cognitive Sciences Center	MIT
Cambridge City Hall Annex	City of Cambridge
Cambridge Park Place Apartments	Oaktree Development
Genzyme Center	Genzyme & Lyme Properties
Harvard Northwest Labs	Harvard University
University Information Systems	Harvard University
Kendall Square Parcel G	Lyme Properties
Schlesinger Library Renovations	Radcliffe Institute for Advanced Study
Russell Field House	City of Cambridge
Stata Center	MIT
Zero Arrow Street	Rolling Breeze

MIT, Harvard, and the City have all adopted green building policies and are all utilizing the LEED guidelines. The new Genzyme Center building in Kendall Square is expecting to be awarded LEED Platinum status, making it one of the most environmentally sustainable buildings in the country. According to the USGBC, 12 of the 73 LEED registered projects in Massachusetts are located in Cambridge. There are additional projects that have been designed with LEED, but for various reasons the owners have chosen not to pursue certification. To encourage private development to design and construct green buildings, the Cambridge Planning Board requires Special Permit applicants to include a LEED checklist and other information in their applications.

As requested by the City Council, representatives from Harvard, MIT, Lesley University, Cambridge College, and the City met in November 2004 to discuss the status of their mutual green building policies and activities. It was agreed that initiation of a best practices exchange would help advance green building approaches in Cambridge.

Trees – In 2004, the City Council passed the Tree Protection Ordinance, which establishes protection for large trees beyond the public street right of way. The ordinance will help maintain the city's tree canopy cover.

Waste Management

40% Recycling Pledge – The City, Harvard, MIT, and the Cambridge Health Alliance jointly committed to a challenge to increase their recycling rates to 40% by December 2005. Since the initial pledge, additional private sector partners have joined.

City Recycling Program - The Public Works Recycling Division is responsible for overseeing the curbside and drop-off recycling programs including recycling at large apartment buildings, city buildings and schools. The recycling rate for FY04 was 33%, or 13,112 tons of waste diverted through waste reduction including recycling and composting, of 39,183 total tons of solid waste. This includes households, city buildings and schools only. A recycling rate for businesses is not available as recycling and waste are collected by many different private haulers.

40% RECYCLING CHALLENGE PARTNERS

City of Cambridge
Harvard University
MIT
Cambridge Health Alliance
Lesley University
Chamber of Commerce
Pfizer, Inc.
Broadway Bicycle
Zipcar
Irving House at Harvard
HMFH Architects
Whole Foods

The curbside recycling program is one of the state's most comprehensive, accepting all mixed paper, cardboard, beverage cartons, plastics #1-7, all glass, metal cans and foil, aerosol cans, seasonal yard waste. Appliances, large metal items, TVs, and computers are also collected separately for recycling. The Drop-off Center, open three days a week, serves all Cambridge residents and businesses or non-profits with 50 employees or less. The Center accepts mixed paper, glass and metal containers, all plastics, cardboard, clothing, books, plastic bags, Styrofoam and hazardous materials including non-alkaline batteries, fluorescent bulbs and mercury devices. Year-round, 6 days a week, residents may bring motor oil to Public Works for recycling as well. Finally, Public Works coordinates several Household Hazardous Waste collection days for residents accepting paint, tires, chemicals, fuels and more.

In order to increase recycling, several proposed actions from the Climate Protection Plan have been taken:

- In winter 2003, a recycling capture rate study was performed through four sorts of residential waste. The study was funded from allocated recycling revenues and performed by DSM Environmental. There were two particularly impressive findings. First, 48% of all waste could be recycled in the existing curbside recycling program. Second, an estimated 1000-1500 tons of paper (such as paperboard and cardboard) could be recycled and diverted from the trash each year. Especially high and low income households could increase paper recycling substantially. (DSM used the Census 2000 median income data and considered all households with incomes greater than 110% of median income high-income households, and all households with income less than 87% of median income low-income households.)

In response to these findings, DPW plans on a pilot distribution of larger recycling containers for paper only to owner-occupied households.

- Expanded electronics collection in September 2003 to include acceptance of printers for curbside recycling. In addition, the Recycling Drop-Off Center began accepting small household appliances under 40 pounds for recycling not including televisions or computer monitors.
- Completed a pilot project in East Cambridge in August 2003 that implemented and evaluated outreach techniques based on principles of social marketing and pro-social behavior to increase recycling participation among 567 identified “non-recyclers”. The study was funded by a DEP grant and performed by Clear View Consulting. Households were randomly assigned to one of four outreach methods: phone, door-to-door, mailed brochure and a control group. Outreach activities to non-recyclers were conducted through a partnership with two local charitable groups, who earned money for their outreach efforts and in direct proportion to the amount recycled by the households contacted. Recycling participation and behavior was monitored three months and one year after the initial outreach.

The door-to-door outreach was the most effective outreach method in terms of making contact and gaining a commitment to participate. 46% of the “door committers” households were recycling one year later. On average, new participating households were found to recycle 360 pounds of material per year.

COMPREHENSIVE PROGRAMS

Harvard University – The Harvard Green Campus Initiative (HGCI) is a comprehensive program aimed at engaging all sectors of the university community in the pursuit of campus sustainability. In September 2004, President Lawrence Summers announced a set of six sustainability principles that will guide campus planning and operations. The principles will be integrated into capital planning and construction and annual financial and budget planning. The university is committed to investing in the support systems to facilitate implementation of the principles and has established a standing advisory committee to provide ongoing review. HGCI programs include:

- *Green Campus Loan Fund* – A \$3 million revolving Green Campus Loan Fund was set up to help the individual schools and departments undertake resource efficiency projects. To date the fund has supported 38 projects, such as lighting retrofits, which have reduced carbon dioxide emissions by 4,400 tons annually. In late 2004, Harvard President Lawrence Summers announced that the loan fund would be doubled to \$6 million, noting that the fund has a high financial rate of return. Harvard was recognized with a Go Green Award for its energy conservation and renewable energy initiatives in 2004.
- *FAS Resource Efficiency Program* – A network of paid student “resource efficiency representatives” help to communicate the resource conservation

message and act as liaison between students and administrators. HGCI credits the program with saving \$200,000 from reduced energy use in the first year.

- *Computer Energy Projects* – Given the thousands of computers used at the university, Harvard is aiming to reduce computer energy costs by \$200,000 and carbon dioxide emissions by 1,433 tons annually. The project is working to change user behavior, ensure proper setting of power management features on computers, and purchase energy efficient equipment.
- *Sustainable Buildings Program* – HGCI staff assist campus planners to design and construct green buildings.

HGCI has also completed Harvard's first greenhouse gas emissions inventory. The whole university, including its Allston and Longwood campuses, contributed about 295,000 metric tons of carbon dioxide in 2003. Since 1992, Harvard's energy use has increased 40 percent, with a proportional increase in greenhouse gases. Harvard attributes this increase to an increase in building square footage, an increase in laboratory intensive research, the proliferation of computers and associated peripheral equipment, and increased building occupant expectations for more space and comfort. About 90 percent of the emissions are related to heating, cooling, and powering university buildings. In the past two years, HGCI's projects have been able to annually reduce GHG emissions by the equivalent of about 5 percent of the 2003 emissions.

Harvard is the third largest purchaser of green power among higher education institutions in the U.S. Harvard Real Estate Services and the School of Public Health have purchased renewable energy certificates for facilities in Boston. In Cambridge, the Kennedy School of Government has purchased 4.2 million kilowatt-hours of wind energy certificates to offset about 50 percent of the schools annual demand. This Kennedy School purchase is funded by a \$5 per semester increase in student fees, which was authorized by a student vote. The fees will continue unless a vote is taken to rescind the fee in the future.

Massachusetts Institute of Technology (MIT) – MIT continues to develop and implement a wide array of initiatives to minimize the Institute's environmental footprint in the community. These activities are focused on minimizing emissions, waste generation, and resource consumption, while maximizing the efficient use of energy, recycling, and waste minimization. MIT's actions to advance a model of campus sustainability is founded in the 2001 adoption of an Institute-wide Environment, Health and Safety Policy that formally establishes MIT's commitment to minimizing its environmental impact and embracing principles of sustainability. Driven by this Institute policy, an integrated approach to campus sustainability is taking shape. A few highlights include:

- *Administrative Leadership:* MIT created the Environmental Programs Office to identify, coordinate, promote, and lead campus sustainability programs, in addition to providing campus Environment, Health and Safety (EHS) services.
- *Sustainability Program Management:* In 2004, MIT assigned a full-time environmental manager to plan, implement and coordinate campus-wide environmental initiatives, including climate protection planning.

- *Environment, Health and Safety Management System:* MIT developed and is implementing an innovative EHS Management System that has established strong accountability, uniform training, standard operating procedures, and continual improvement mechanisms to promote environmental stewardship and safe and healthy work conditions on campus.
- *Green Building:* MIT recently adopted an Institute policy that requires all new buildings and major renovations to be “green buildings” and achieve LEED Silver or better certification. In 2004, the Stata Center was commissioned, achieving LEED Silver certification. The Stata Center employs an innovative stormwater retention system to divert untreated stormwater from reaching the Charles River. The system captures the runoff and, through a solar-powered pump system, recycles the water for building sanitary flushing. In 2005, the new McGovern Brain and Cognitive Sciences Building is expected to achieve LEED Silver status. These initiatives reduce GHG emissions and minimize resource consumption.
- *Recycling & Waste Prevention:* Through implementing a variety of recycling optimization programs over the past several years, MIT has increased its recycling rate from 5% to over 22% of total waste. An Institute-wide food composting program has been implemented that diverts over 20 tons of food waste per month to productive uses. An Institute-wide “green goods” procurement policy and program have significantly increased the purchase of recycled paper and office products with recycled content. The environmentally preferable products (EPP) purchasing policy issued by the Executive Vice President states, "To continue MIT's concerted efforts toward a sustainable future, and to save dollars in both purchasing and handling goods, purchase recycled products whenever possible."
- *Greenhouse Gas Inventory:* MIT has recently completed its first greenhouse gas emissions inventory. In 2003, MIT's total GHG emissions included approximately 230,593 tons of CO₂. Of the total, 90 percent was attributed to utility emissions associated with the cogeneration facility and purchases of electricity from NSTAR, 9.5 percent was from transportation, and 0.5 percent from waste disposal. Since 1990, MIT has seen a 12.4 percent increase in GHG emissions according to its analysis.
- *Co-Generation:* MIT provides much of its own energy needs with the co-generation facility located on Vassar Street. The 20 megawatt COGEN facility started operation in 1995 and produces electricity and steam more efficiently than the New England electricity generating network. Based on 1998 data, the plant reduces CO₂ emissions annually by 77,000 tons compared to 1990 conditions. Since the opening of the facility, power needs have grown and MIT has purchased increasing amounts of electricity from NSTAR to meet its needs. A current research project at the COGEN plant in conjunction with GreenFuel Technology Corporation has demonstrated that an array of algae-based bioreactors can significantly reduce GHG and other pollutants in the plant's air emissions up to 85%.

EDUCATION AND CIVIC ENGAGEMENT

Ecoteams – The City has initiated a pilot project to evaluate the use of the “ecoteam” model to raise the awareness of residents in their household environmental impact and to identify and motivate residential actions to reduce GHG emissions. The Community Development Department has contracted with Sustainable Step New England, a regional non-profit organization, to support the project. The project aims to recruit about 10 teams of residents and others to conduct self-audits of household practices involving energy, transportation, waste, and water. The self-audits are based on a work book and method developed by the Empowerment Institute. Various recruitment approaches, including using workplaces, places of worship, and multi-family residential complexes, are being tried and the effort will be evaluated at the end of FY05.

Grassroots Organizations – In 2004 a grassroots organization of Cambridge residents, called Green Decade/Cambridge, was formed. It was established with the objective of supporting and working with the City to educate and engage residents, businesses, and institutions in climate protection. It has published articles in the Cambridge Chronicle, assisted with the Energy Fair, has a legislative advocacy network, and is undertaking initiatives to support clean energy generation. Green Decade/Cambridge is an affiliate of the Massachusetts Climate Action Network (MCAN).

In 2004, MCAN held its Annual Grassroots Climate Action Conference in Cambridge at MIT, drawing large numbers of Cambridge residents to participate. Over 600 people attended an Army Corps of Engineers hearing on the Cape Wind energy project held at MIT in December 2004, again indicating a growing public awareness in Cambridge and surrounding communities of global warming and an interest in supporting clean energy production.

University Courses – Since 2003, the Laboratory for Energy and Environment of MIT has been working with the Community Development Department to offer an intersession course on implementing the Climate Protection Plan. Community-based social marketing concepts have been used to organize the course. Students have organized into teams to develop recommendations on community actions that would contribute to GHG reductions. Reports have been produced on marketing green power, promoting the purchase of hybrid and high fuel economy vehicles, and promoting a “walking bus” program for school children.

In the spring of 2004, MIT’s Planning for Sustainable Development course focused on the Climate Protection Plan. Student teams analyzed three sectors of the community to understand decision-making and the potential to engage those sectors in the goals of the plan. MIT, the business community, and neighborhood organizations were assessed.

Both courses have provided an opportunity for MIT faculty, students, and staff to interact with City staff and explore possible ways for MIT and the City to collaborate on achieving the goals of the plan.

In 2004, a course titled “Sustainability: The Challenge of Changing our Institutions” was offered through the Harvard Extension School. The course focused on understanding institutional behavior, assessing environmental impacts, and developing effective strategies for organizational change. Harvard University and the Green Campus Initiative were used as the primary case examples. The course is offered again in the Spring 2005 semester and offers an opportunity for other organizations to learn from the Green Campus Initiative’s experience at Harvard.

Cambridge-Yerevan Sister Cities – Cambridge and Yerevan, Armenia have a long-standing sister city relationship supported by the Cambridge-Yerevan Sister City Association (CYSCA). With the support of a grant from the U.S. State Department, CYSCA has undertaken a project to facilitate an exchange between the Tobin School and the Vardanantz Aspetner Education Complex in Yerevan to study energy and climate. The students interact via the Internet and video conferences. In November, 45 Tobin School students, led by teacher Tad Sudnick, toured City Hall Annex to learn about green buildings as part of the project.

Go Green Awards – The City honors businesses and organizations annually for sound environmental practices. In 2004, an energy category was added to the City’s Go Green Awards, which recognize environmental excellence in Cambridge. Awards for energy were given to the Harvard Green Campus Initiative, MIT for its cogeneration facility, Genzyme for constructing its new, green corporate headquarters, and Hines for energy performance improvement at One Main Street. Awards for transportation demand management were given to Arup and ADD, Inc. and for recycling to Whole Foods Markets and Hines.

MassCCP – Staff from Massachusetts cities and towns that participate in Cities for Climate Protection maintain a network to exchange information and experiences. Sessions have been held on topics such as how to prepare greenhouse gas emission inventories. In November 2004, the group hosted a visit of municipal staff from Porto Alegre, Brazil, a CCP participant, who toured Boston area communities to learn about local climate protection initiatives in the U.S.

EVALUATION OF PROGRESS

Greenhouse gas emissions from activities in Cambridge are increasing. However, there are promising trends. Emissions from the residential sector are declining. Recycling has significantly reduced emissions from waste generation. Commercial and industrial buildings are becoming more energy efficient.

The community is becoming increasingly aware of the local contribution to climate change. The major universities have conducted their own greenhouse gas emissions inventories and are assessing their operations in terms of these emissions. Businesses like Hines and Genzyme are seeing the linkage between energy efficiency, renewable energy, and GHG emissions and the financial benefits of acting to reduce emissions.

Community action to date can be characterized as exploratory or in an early stage. Individual organizations are investigating and gaining experience in developing approaches to greenhouse gas emission reductions, which will hopefully lead to more comprehensive and aggressive programs.

Regional, state, and local governments are acting in innovative and effective ways to reduce emissions and creating a significant cumulative impact. Many businesses are not waiting for government to act and are integrating climate protection goals and actions into their operations. Civic organizations are not only imploring others to act but are offering an example by greening their operations. The state has issued its Climate Protection Plan and is engaged in a variety of initiatives.

The challenge of reversing and reducing greenhouse gas emissions has grown. To accomplish the goals of the Climate Protection Plan, the Committee finds the Cambridge needs to:

- Develop a community-wide campaign that engages a significant number of businesses, institutions, organizations, and citizens.
- Increase efforts to increase energy efficiency, particularly in the existing commercial/industrial building stock.
- See that new buildings exceed the state energy code requirements.
- Greatly expand the purchase of renewable energy certificates and installations of renewable energy generating facilities.
- Encourage and facilitate businesses, organizations, institutions, government agencies, and residents to purchase fuel efficient and alternative fuel vehicles.
- Continue to press for increased use of alternatives to single-occupancy auto trips.
- Continue to prevent waste and increase recycling.

2005 PLANS AND OPPORTUNITIES

Pledge program – The City is planning to revamp the Go Green awards to create a program where businesses and community organizations can support the goals of the Climate Protection Plan and achieve greater levels of recognition based on the accomplishment of actions that reduce greenhouse gas emissions. This program will cover energy, transportation, and waste management activities. With this program, the City hopes to engage larger numbers of community partners.

Clean Energy Choice – The Massachusetts Technology Collaborative has started a new program to provide incentives to residents and businesses to purchase renewable energy certificates. Within the NSTAR service territory, MTC will match all purchases of New England Wind RECs from the Massachusetts Energy Consumers Alliance. The matching funds are made available to the municipalities in which the purchases are made in the form of clean energy grants. This program offers the opportunity to generate funds for projects in Cambridge to reduce GHG emissions.

Energy Star Recruitment Project – The City is conducting a pilot project which will recruit local businesses and organizations to become partners in the federal Energy Star program. The program will leverage Energy Star tools and NSTAR energy services to encourage energy efficiency improvements.

Ecoteams – The Community Development Department intends to continue recruiting Ecoteams to audit household environmental practices and encourage action to reduce impacts, particularly greenhouse gas emissions.

Energy Fair – Given the success of the 2004 Energy Fair, the Community Development Department is planning to repeat and expand the event at Danehy Park Family Day in 2005. By continuing to partner with NSTAR, a large number of Cambridge households can be provided with information about energy conservation incentives and services.

NSTAR Air Conditioner Turn-In – The Community Development Department is working with NSTAR to schedule an air conditioner turn-in event, probably in the spring of 2005. Past events in other communities have led to the turn-in and replacement of thousands of old inefficient air conditioners. Participants are given \$75 rebate coupons for use in the purchase of Energy Star rated air conditioners.

Green Building Best Practices Exchange – Harvard, MIT, Lesley University, Cambridge College, and the City have agreed to initiate a best practices exchange on green buildings and related topics to promote more energy efficient and environmentally sustainable buildings.

City Initiatives – City departments will continue to improve energy efficiency in municipal buildings, build new buildings to LEED standards, increase employee participation in transportation programs, and increase the rate and range of recycling. The City will also develop a green fleets policy for vehicle acquisition.

Monitoring – The Committee will continue to monitor the status of GHG emissions in Cambridge. While it may not be efficient to update the full GHG emissions inventory every year, various indicators can be gathered and assessed. These indicators include consumption of electricity and natural gas, vehicle registrations, and waste generation and recycling rates. These indicators will be reported in the 2005 annual report.

APPENDICES

2003 Update of the Cambridge Greenhouse Gas Emissions Inventory

Annual Report References and Sources

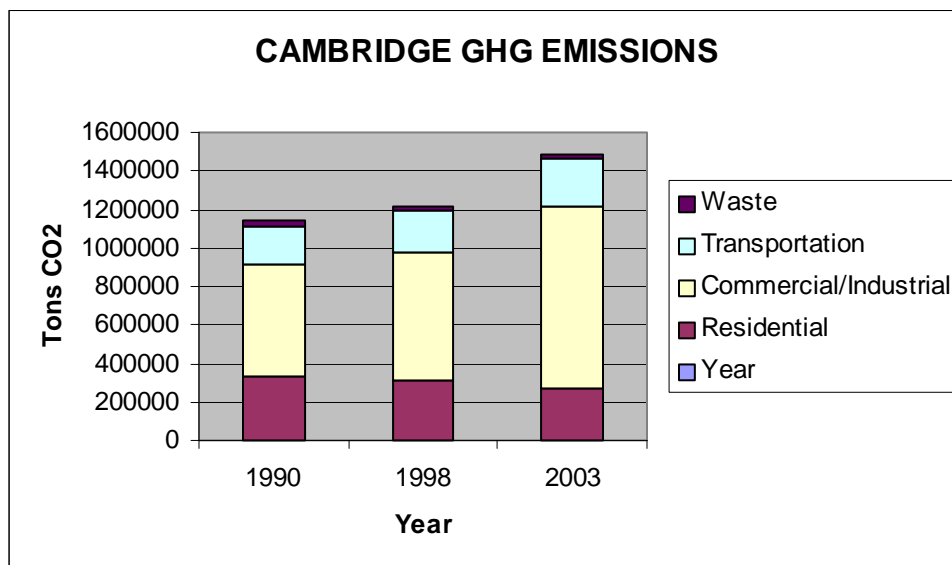
APPENDICES

CAMBRIDGE GREENHOUSE GAS EMISSIONS INVENTORY 2003 UPDATE

Total Greenhouse Gas Emissions

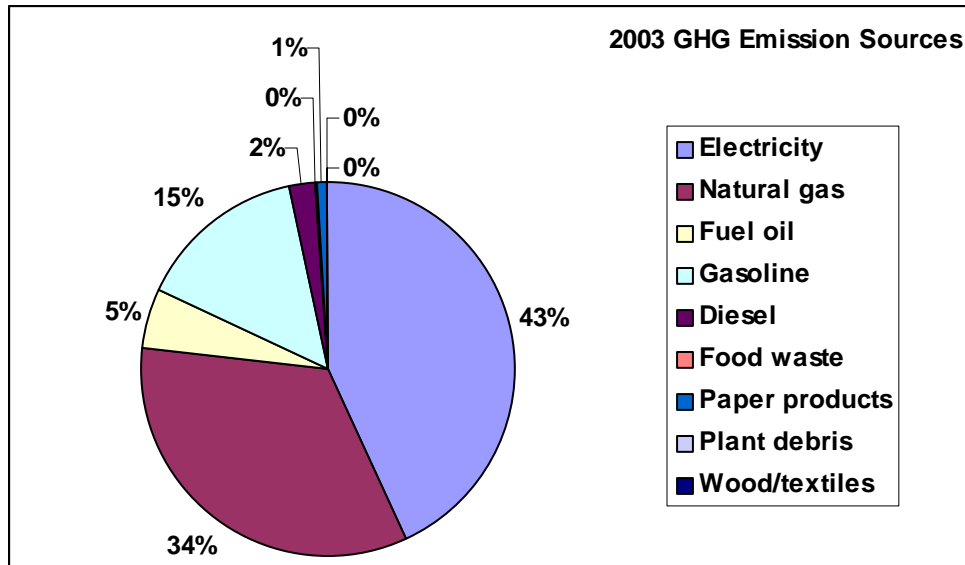
In 2003, total greenhouse gas emissions for Cambridge amounted to 1,582,218 tons equivalent carbon dioxide (eCO₂). This represents an increase of 317,583 tons eCO₂ or 27%.

<i>Cambridge GHG Emissions (tons CO₂)</i>			
<i>Year</i>	<i>1990</i>	<i>1998</i>	<i>2003</i>
Residential	325,431.50	309,865.60	263,266.70
Commercial/Industrial	582,862.80	667,355.10	951,944.90
Transportation	205,855.40	218,960.40	251,929.10
Waste	23,484.80	14,886.60	15,117.80
Total GHG Emissions	1,164,634.60	1,211,067.70	1,482,218.40



To put this into context, Cambridge's GHG emissions represent a little over 1 percent of total Massachusetts emissions (the Commonwealth reports total emissions of 123,726,240 tons eCO₂ in 2001).

Based on sources, electricity (43.0%), natural gas (33.7%), and gasoline (14.7%) were the top 3 contributors to total emissions in 2003. Since 1990, the contributions from these sources has remained relatively steady: electricity (39.3%), natural gas (32.9%), gasoline (15.5%).



The total Cambridge emissions of 1,482,218 tons eCO₂ are equivalent to the following, based on U.S. Climate Technology Cooperation's equivalency calculator:

3,127,083 barrels of oil or
 18,025 tanker trucks filled with gasoline or
 1,120,538 acres of pine or fir forest storing carbon for one year or
 11,022 acres of forest preserved from deforestation

On a per capita basis, Cambridge compares favorably to national emissions. The 2003 per capita emissions for Cambridge was 14.6 tons/person. The U.S. per capita emissions for 1999 was 23.3 tons/person, according to the World Resources Institute.

Compared to other Massachusetts communities, Cambridge's 14.6 tons per capita emissions is slightly higher than Newton and Worcester, which were 13.6 and 11.9 in 2002. Nationally, Portland, OR reports a 2001 per capita emission rate of 17.2 tons/person and Fort Collins, CO reported 17.4 tons/person for 2002.

COMPARISON OF PER CAPITA GHG EMISSIONS

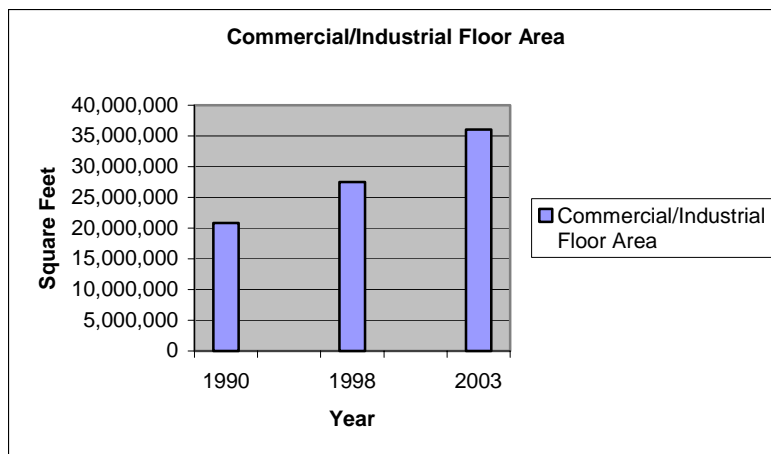
<u>Community</u>	<u>Tons CO₂/Person</u>
U.S. wide (1999)	23.3
Fort Collins, CO	17.4
Portland, OR	17.2
Cambridge, MA	14.6
Newton, MA	13.6
Worcester, MA	11.9

Commercial/Industrial Emissions

GHG emissions from the commercial/industrial (C/I) sector constitute the most significant source in Cambridge, accounting for 64.2 percent of total emissions. This sector's share of the community's emissions has risen from 50 percent in 1990.

Possible factors that explain the increasing C/I emissions include:

- Expanding commercial and industrial floor area
- More energy-intensive building uses (e.g., laboratories)
- More energy-consuming equipment in buildings (e.g., computers)



Analysis of building energy use on the MIT campus indicates that laboratory buildings are much more energy-intensive than other types of buildings including offices. During the 1990s and early 2000s, laboratory space has expanded significantly in Cambridge with the rise of biotechnology in both the commercial and academic sectors. Laboratories tend to be more energy intensive because they are required for health and safety reasons to provide ventilation with a high number of air exchanges and fume hoods used in labs are significant energy consumers.

COMPARISON OF CO₂ EMISSIONS PER SQUARE FOOT IN MIT BUILDINGS, 2003

<u>Building Type</u>	<u>Tons CO₂ per Square Foot</u>
Lab	0.033
Office	0.014
Housing	0.011

T.A. Groode, A Methodology for Assessing MIT's Energy Use and Greenhouse Gas Emissions, Master's Degree Thesis, Massachusetts Institute of Technology, 2004

While no data has been found regarding buildings in Cambridge, computer equipment use dramatically expanded in the U.S. during the 1990s, which may have contributed to increased energy use in commercial and industrial buildings. Or it may have offset some of the decrease in energy use contributed by improvements in the efficiency of other areas, such as lighting.

While total emissions from the C/I sector increased, it appears that the sector has made modest gains in efficiency. On a per square foot basis, emissions decreased from 0.028 tons CO₂/s.f. in 1990 to 0.026 tons CO₂/s.f. (or from 56 lbs. CO₂/s.f. to 53 lbs. CO₂/s.f.), an approximately 5% improvement.

Within the C/I sector, electricity use is the predominant source of emissions, accounting for 58.8 percent of the sector's GHG emissions in 2003. C/I electricity use also accounts for 37.8 percent of the community's total emissions.

Residential Emissions

GHG emissions from the residential sector have decreased from 352,431 tons CO₂ in 1990 to 263,226 in 2003, or 25 percent.

Analyzing the sources of emissions in this sector, electricity use increased 32 percent from 1990 to 2003, while natural gas and fuel oil use decreased by 36 percent and 38 percent respectively. Since natural gas is the major source of emissions in the residential sector, the decrease in natural gas use combined with the fuel oil decrease more than offset the increased emissions from rising electricity use. Natural gas and fuel oil are used primarily for winter heating. Therefore it appears that residential heating has become significantly more efficient since 1990. Possible causes could include improvements to building envelopes (e.g., roof and wall insulation, better windows), replacement of old heating furnaces and boilers with more new, efficient equipment, and increased use of programmable thermostats. These improvements could have followed the end of rent control as building owners started renovating more. NSTAR's conservation programs have also evolved over that period and helped to effect improvements.

The rise in electricity usage makes sense considering that households have tended to become more affluent. Affluent households tend to have more energy consuming devices such as computers, televisions, and other electronic equipment.

The decrease in emissions occurred as the population grew and the number of households increased. Consequently, emissions per household and per capita in the residential sector decreased significantly.

RESIDENTIAL EMISSIONS PER HOUSEHOLD

<u>Year</u>	<u>Tons CO₂ per Household</u>	<u>% Change</u>
1990	8.9	
1998	7.6	-14.6
2003	6.2	-30.3

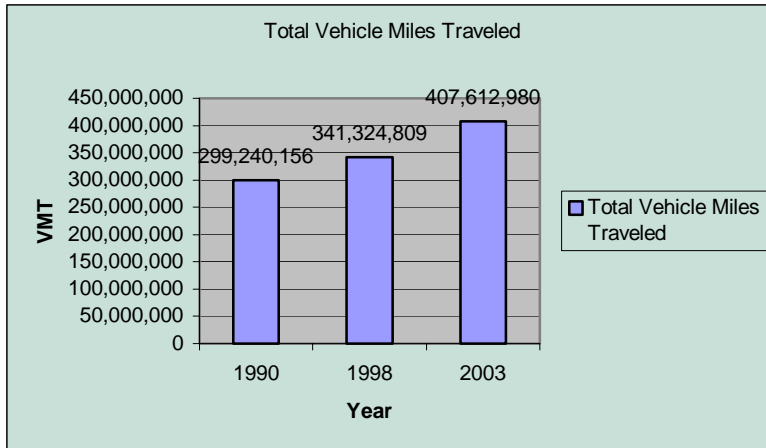
RESIDENTIAL EMISSIONS PER CAPITA

<u>Year</u>	<u>Tons CO₂ per Person</u>	<u>% Change</u>
1990	3.7	
1998	3.1	-16.2
2003	2.6	-29.7

Transportation Emissions

Emissions from the transportation sector increased from 205,855 tons CO₂ in 1990 to 251,929 tons CO₂ in 2003, or a 22 percent increase. Transportation's share of total emissions has remained relatively stable at about 17 percent.

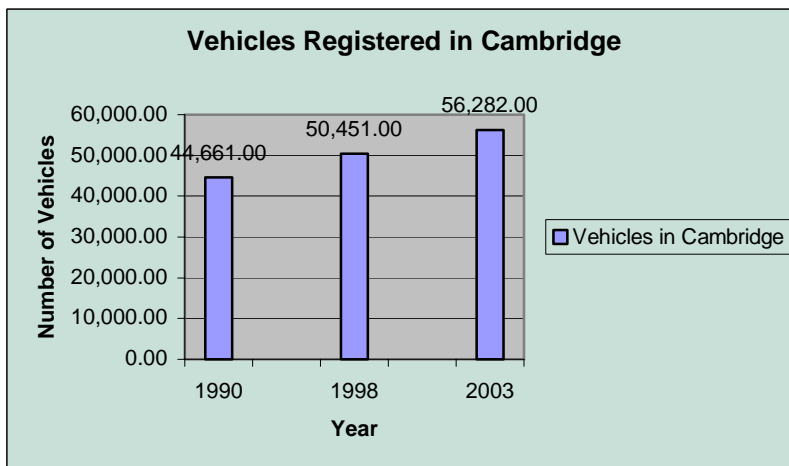
Transportation emissions consist of gasoline and diesel fuel use by vehicles and electricity use in the subway system. Unlike a source such as commercial electricity use, where a specific number can be obtained for the amount of usage, transportation emissions are estimated using regional transportation models and an assumption about average fuel economy. The Central Transportation Planning Staff (CTPS), a state agency, provided the City with the total vehicle miles traveled calculated by its model. These data are used in decision-making about regional transportation projects. VMT includes all vehicle trip segments within Cambridge, whether they originate in Cambridge or outside. Commute trips that pass through Cambridge are included as well as trips that are wholly within the city. Average fuel economy is based on national statistics and do not reflect the local or regional vehicle mix.



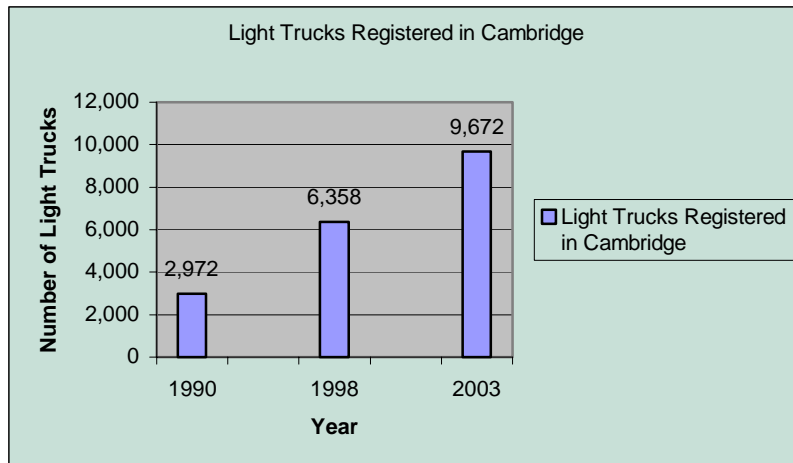
Possible reasons for increased transportation emissions include:

- Increased economic activity in the Boston region creating more automobile trips for commuting and business activity
- Increased population in Cambridge creating more commute trips and personal trips
- Increased number of vehicles in Cambridge
- Increased number of vehicles with lower fuel economy

Data on vehicle registrations in Cambridge indicate a significant increase in the ownership of automobiles. From 1990 to 2003, vehicle registrations in Cambridge increased by 11,621, a 26 percent rise. Vehicles registered per household increased from 1.1 to 1.3. The 2003 vehicle population also includes a greater proportion of light trucks.



In 1990, 2,972 light trucks were registered in Cambridge, or 6.7 percent of registered vehicles. In 2003, 9,672 light trucks were registered, or 17.2 percent. Sport utility vehicles became popular in the 1990s and probably account for most the growth in light trucks, although the data do not distinguish SUVs. SUVs are generally less fuel efficient than sedans.



Waste Emissions

The inventory includes GHG emissions that result from the disposal of solid waste at incinerators and landfills. The incineration of organic wastes results in the emission of carbon dioxide. Decomposition of organic wastes in landfills results in the release of methane, another greenhouse gas that is 20 times more potent in trapping heat than CO₂. All portions of solid waste do not release GHGs upon disposal. Paper, food, plant material, and wood are the primary components of the waste stream that release GHGs. Waste stream composition is accounted for in the inventory.

Emissions from waste disposal have decreased since 1990, dropping from 23,484 tons CO₂ to 15,117 tons CO₂. Wastes are a small portion of the total GHG emissions, representing about 1 percent. In this inventory, only wastes collected by the City's trash collection and recycling programs have been considered. This covers most residential waste and a small proportion of businesses, as well as municipal facilities. Wastes that are privately collected, which includes most of the business and institutional sectors, has not been included due to the lack of data. Statewide statistics suggest that waste from the business and institutional sectors would probably match or exceed the municipally collected waste. Therefore if it was able to be accounted for, then the emissions from this sector would probably double.

The reduction of emissions from waste is largely due to the introduction of the Cambridge Recycling Program in 1990. Waste disposal tonnage began to decline immediately. Since 1998, the emissions from waste disposal have roughly leveled off as the recycling rate plateaued.

Note About the Inventory Methodology

The Cambridge Greenhouse Gas Emissions Inventory has been prepared using the Clean Air and Climate Protection Software developed for ICLEI, the sponsor of Cities for Climate Protection, and the STAPPA/ALAPCO, which is an association of state and local air pollution control officials. The software includes region specific coefficients that are used in calculating emissions. The software was recently updated. Consequently, the

emissions for 1990 and 1998 that appear in the 2004 Annual Report differ from those that appear in the Climate Protection Plan issued in 2002. However, the inventory results reported in the 2004 Annual Report updates the 1990 and 1998 results using the new software and are comparable to the 2003 results. Questions may be directed to John Bolduc, jbalduc@cambridgema.gov. For general information about the CACP software, see <http://www.cacpsoftware.org/>.

Climate Protection Action Committee 2004 Annual Report

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Hines – Riverfront Office Park
http://www.energystar.gov/index.cfm?fuseaction=labeled_buildings.showProfile&profile_id=1000806

Cambridge Vehicle Trip Reduction Ordinance
<http://bpc.iserver.net/codes/cbridge/index.htm>

Cambridge Parking & Transportation Demand Management Ordinance
<http://www.cambridgema.gov/~CDD/et/tdm/index.html>

Genzyme Center
http://www.genzyme.com/genzctr/genzctr_home.asp

Cambridge Recycling Program
<http://www.cambridgema.gov/TheWorks/departments/recycle/index.html>

Harvard Green Campus Initiative
<http://www.greencampus.harvard.edu/>

MIT Environmental Programs
<http://web.mit.edu/environment/index.html>

Massachusetts Climate Action Network
<http://www.massclimateaction.org/>

MIT Laboratory for Energy and the Environment
<http://lfee.mit.edu/>

Cambridge-Yerevan Sister City Association
<http://www.cysca.org/>

Go Green Awards

http://www.cambridgema.gov/~CDD/et/ggm/ggb_awhist.html

Clean Energy Choice

<http://www.cleanenergychoice.org/>